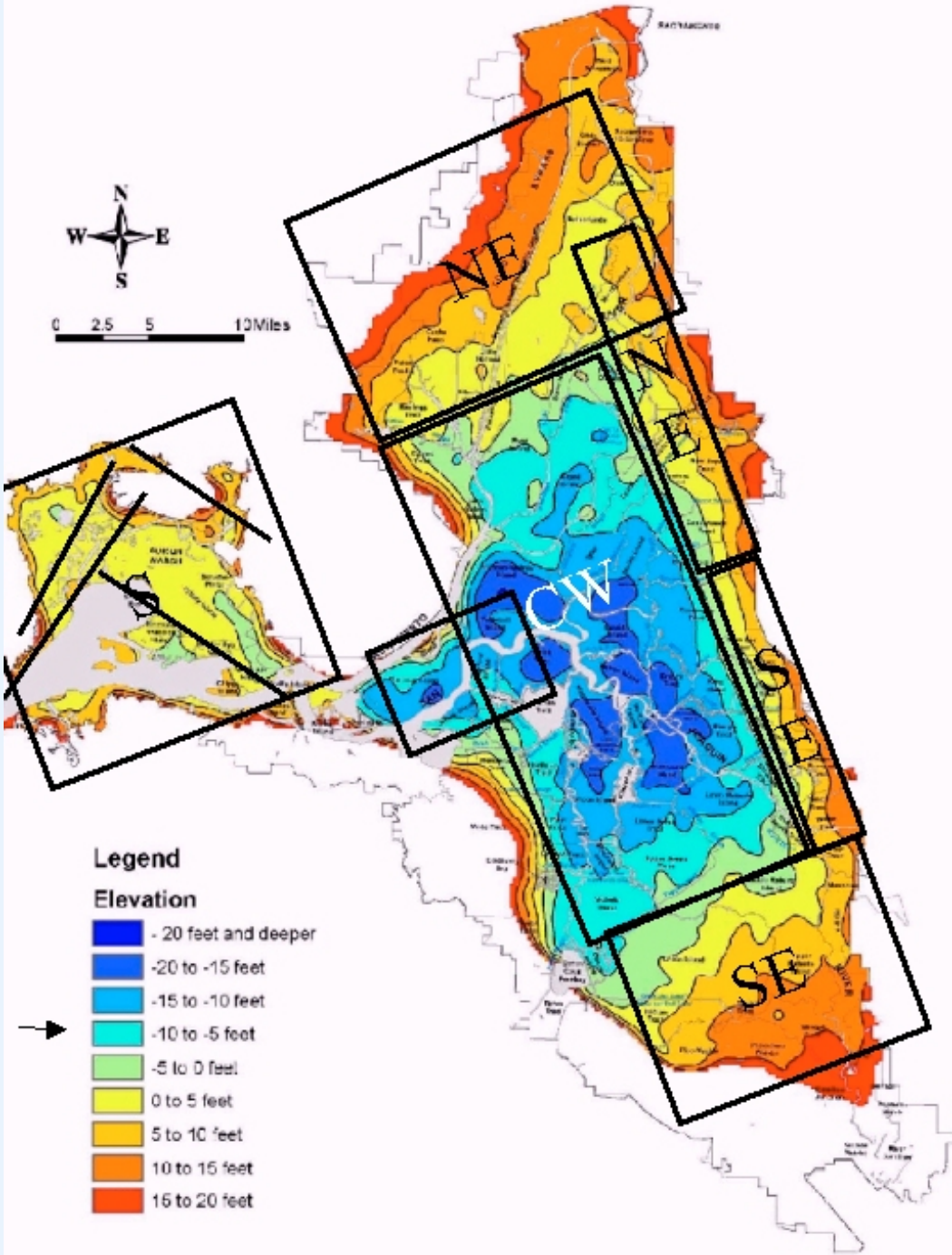
Implications of Drivers of Change for the Delta's valued services

Presentation to the Stakeholder Coordination Group
Sterling Hotel, April 3, 2007

Robert Twiss
Professor Emeritus UC Berkeley,
Consultant to DRMS / Delta Vision


N
W
E
S
0 2.5 5 10Miles
NE
NE
CW
SE
SE
Legend
Elevation
- 20 feet and deeper
-20 to -15 feet
-15 to -10 feet
-10 to -5 feet
-5 to 0 feet
0 to 5 feet
5 to 10 feet
10 to 15 feet
15 to 20 feet

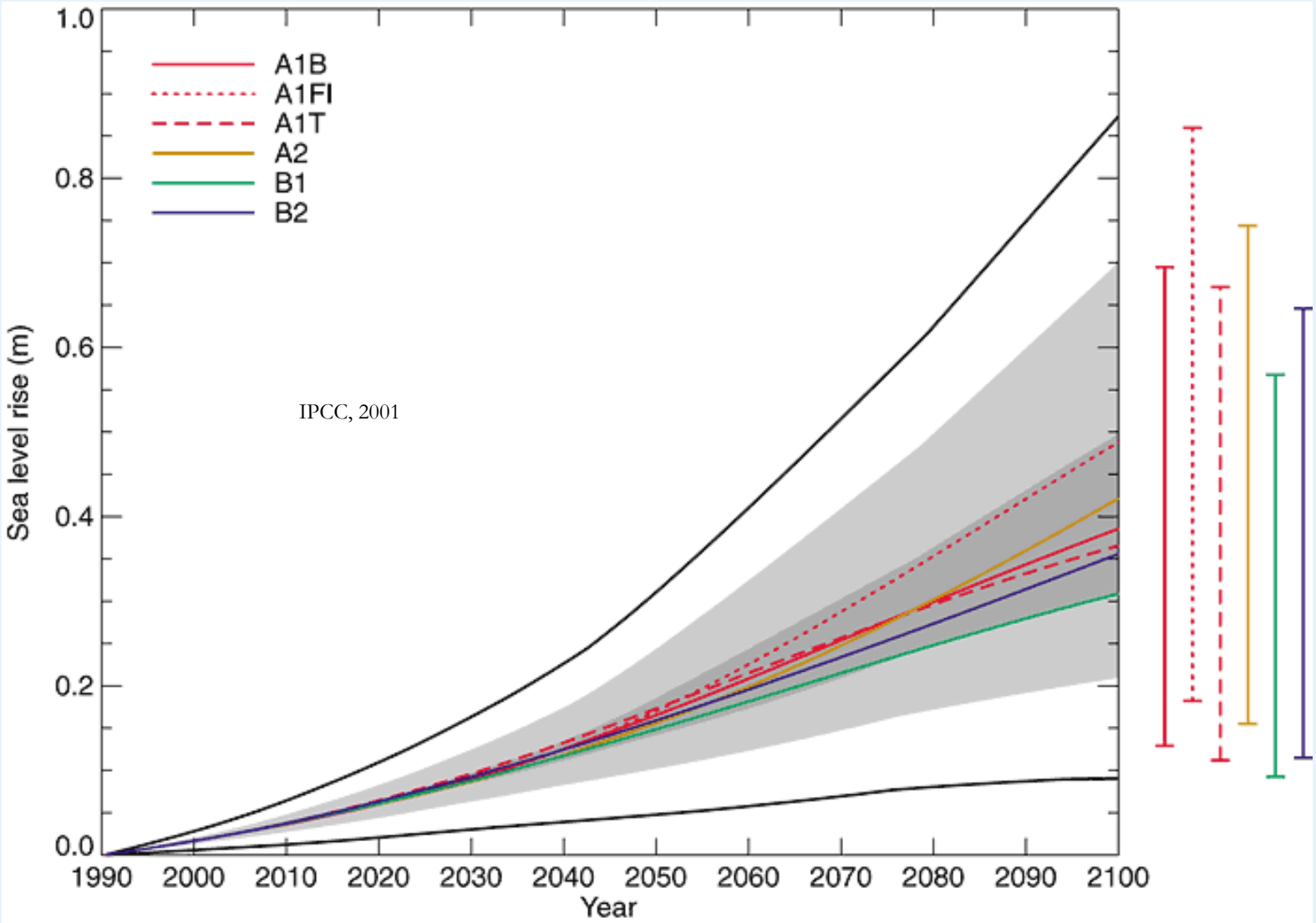
Current & future uses and services:

Ag / W Supl / WQ / Flood Contrl / Dilution / Shipg / Rec. / Infra / Eco / Hist towns

Current situation and problems, plus

Subsidence / S-L Rise / Climate / Quakes / Exotics / Pop & Urbanization

Sea Level Rise



1				
2				
3	**Values for global sea level rise**			
4				
5	2100		cm	inches
6		Ramstorf high	140	55
7		Ramstorf mid IPPC TAR high	90	35
8		Ramstorf low IPCC TAR mid	50	20
9		linear extrapolation	20	8
10				
11	2050			
12		Ramstorf high	41	16
13		Ramstorf mid IPPC TAR high	30	12
14		Ramstorf low IPCC TAR mid	20	8
15		linear extrapolation	11	4
16				
17				
18	Source: DRMS Climate Change TM			
19		URS / Philip Duffy		
20				

Local, recent measurements:

9.11 ft => 9.27 ft = 1.6 ft (1.9 in.)
in two years

Not relevant or appropriate to use such short-term changes

	MSL for year	19 year mean
San Francisco GG		
2004	9.11	9.09
2005	9.18	9.09
2006	9.27	9.10

Acceptable level of Risk? Each service sector or stakeholder interest will want to determine its own level of acceptable risk. But for planning purposes, we may need to set definitive levels for analysis of proposals (as in Netherlands strategic planning).

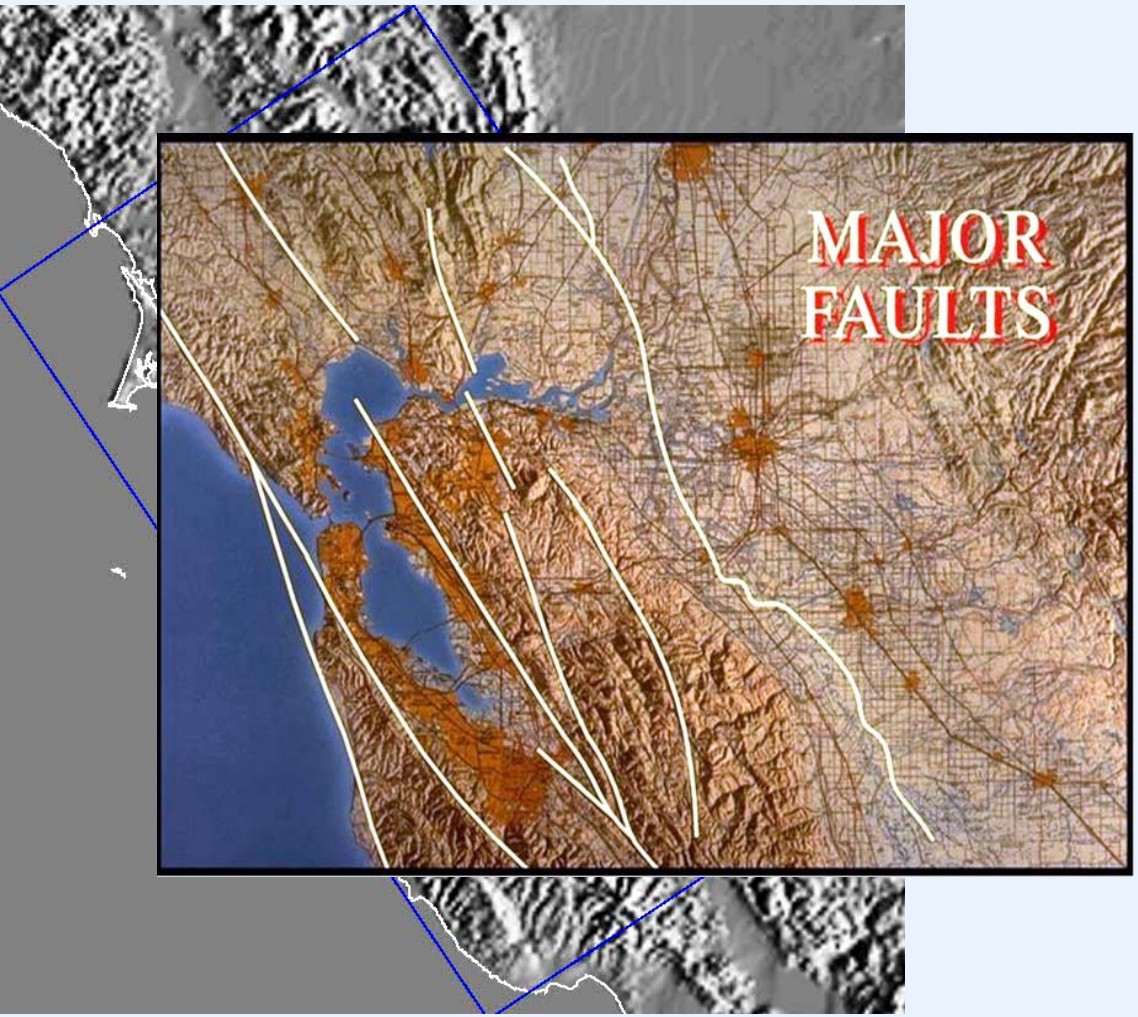
High protection, **low tolerance**: roads and bridges, rail, police/fire, hospitals, urban/suburban, communications, water treatment, chemical storage, fuel lines. For heavy investments and irreversible actions, should lower probability figures and the year 2100 values be used (instead of optimistic estimates and a 50 year horizon)?

Moderate: Farm equipment, vineyards, orchards, commercial recreation, ….

Lower protection, higher risk acceptable: row crops, conservation, hunting clubs,

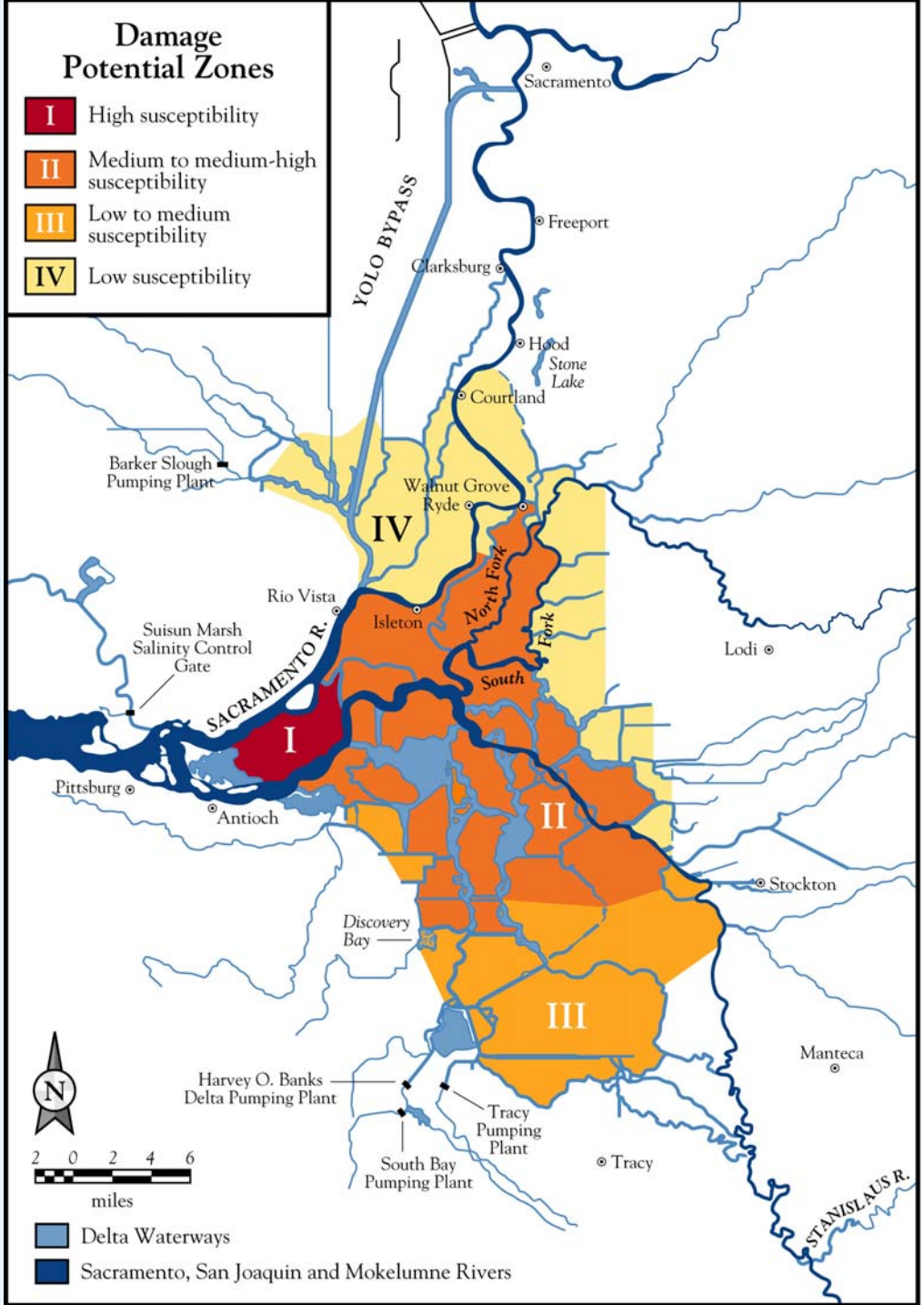
Setting levels and targets is not science, but clearly a policy decision, advised by science.

Seismicity

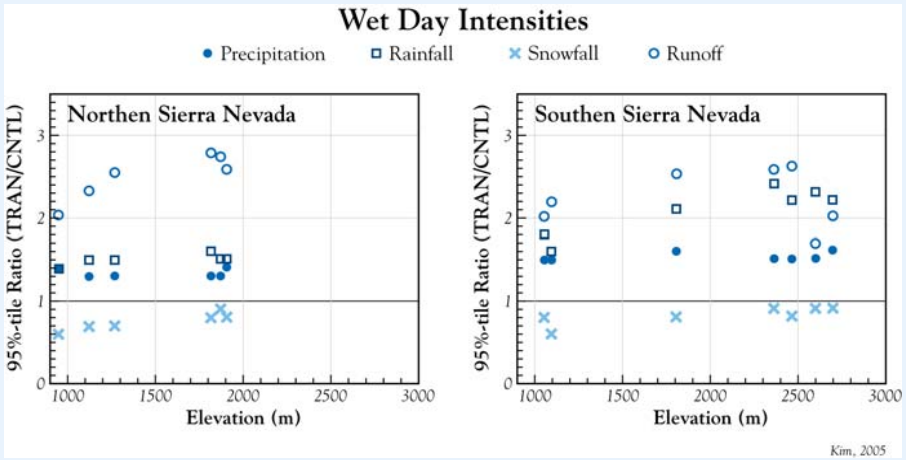


- Risk of levee failure significant at any time scale
- Risk highest in western Delta
- Unlike flood risk, seismic risk increases with time

At this point, pass this off to the real experts!

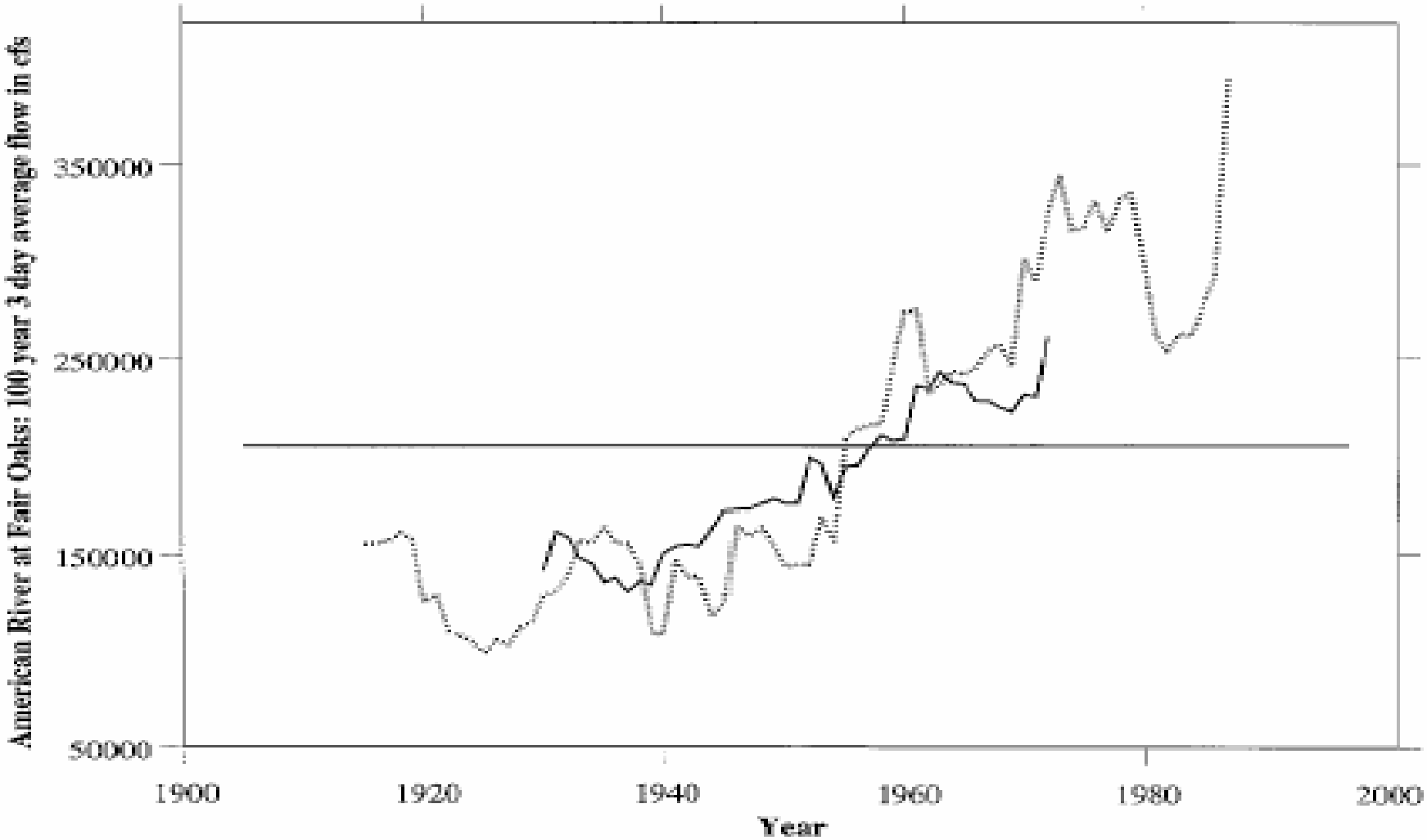

Damage Potential Zones
I High susceptibility
II Medium to medium-high susceptibility
III Low to medium susceptibility
IV Low susceptibility
Sacramento
YOLO BYPASS
Freeport
Clarksburg
Hood
Stone Lake
Courtland
Barker Slough Pumping Plant
Walnut Grove
Ryde
IV
Rio Vista
Isleton
North Fork
South Fork
Lodi
Suisun Marsh Salinity Control Gate
SACRAMENTO R.
I
Pittsburg
Antioch
II
Stockton
Discovery Bay
III
Manteca
Harvey O. Banks Delta Pumping Plant
Tracy Pumping Plant
South Bay Pumping Plant
Tracy
STANISLAUS R.
N
2 0 2 4 6
miles
Delta Waterways
Sacramento, San Joaquin and Mokelumne Rivers

Changes in Runoff Conditions: High Flows*



- Timing of peak runoff shifting to winter
- Intensity of winter storm events appears to be increasing
- Downscaled models suggest continued increase in intensity and frequency of high runoff events

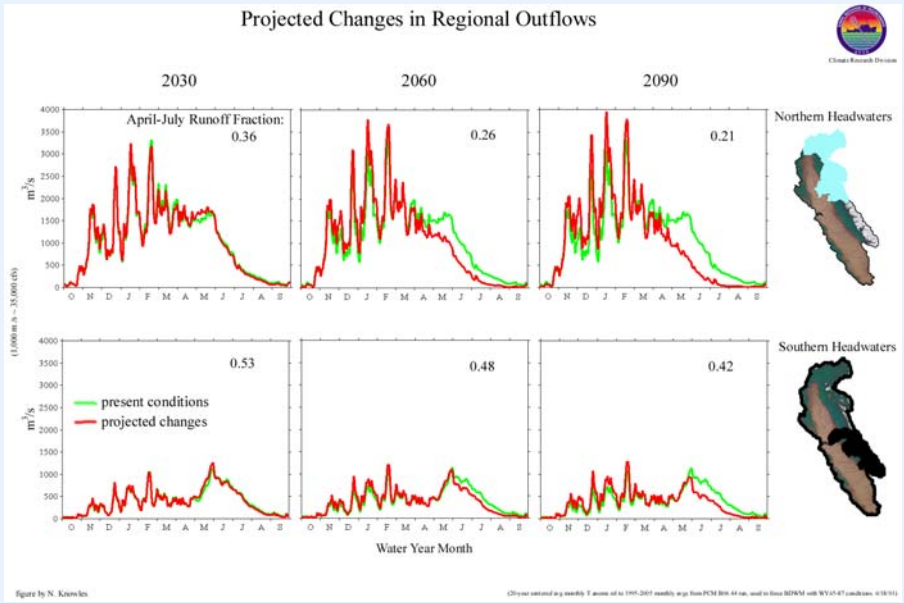
*modulated by water operations

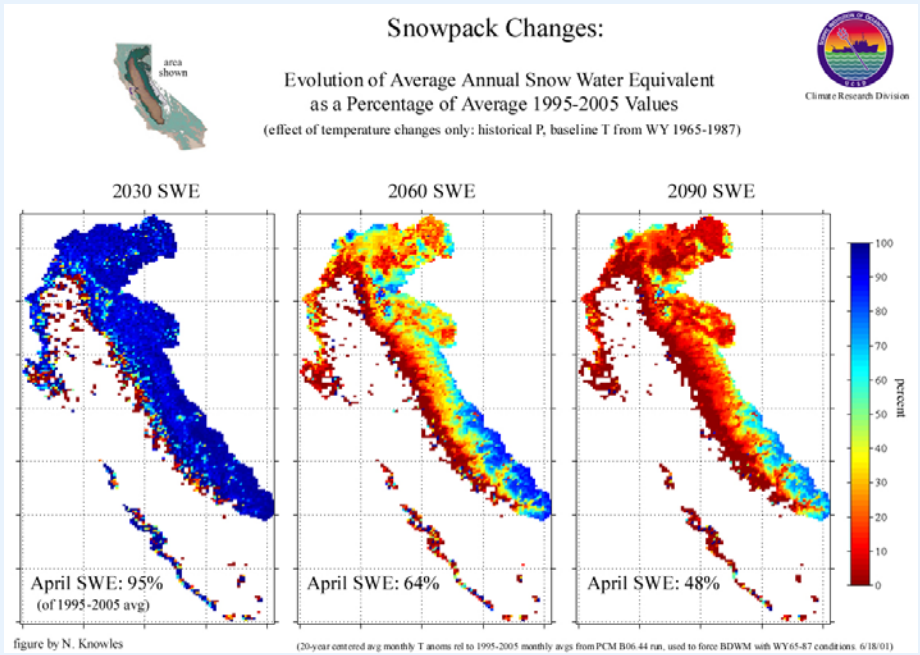


Unregulated 3-day Rainflow, Fair Oaks, American River

From: NRC, 1999 ? check

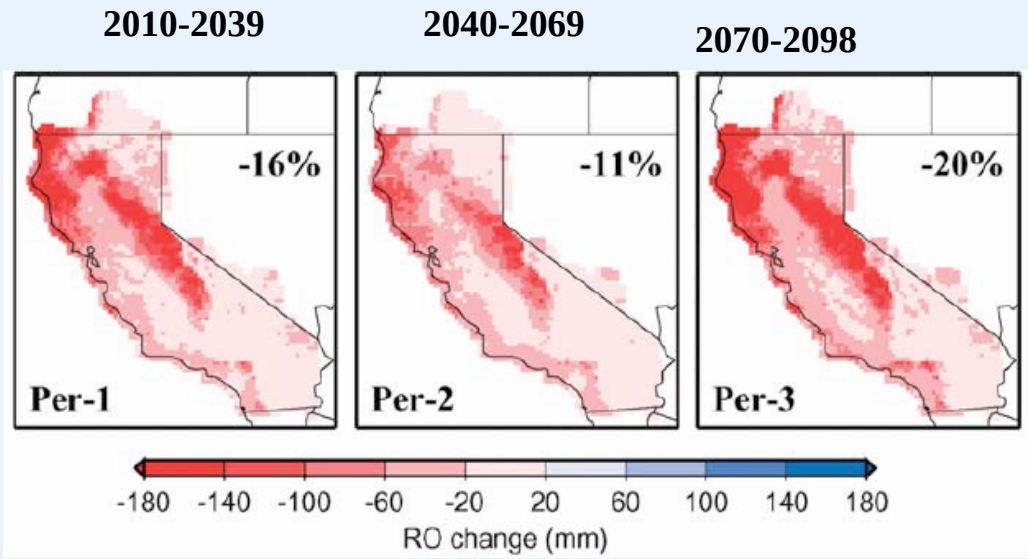
Changes in Runoff Conditions: Low Flows*

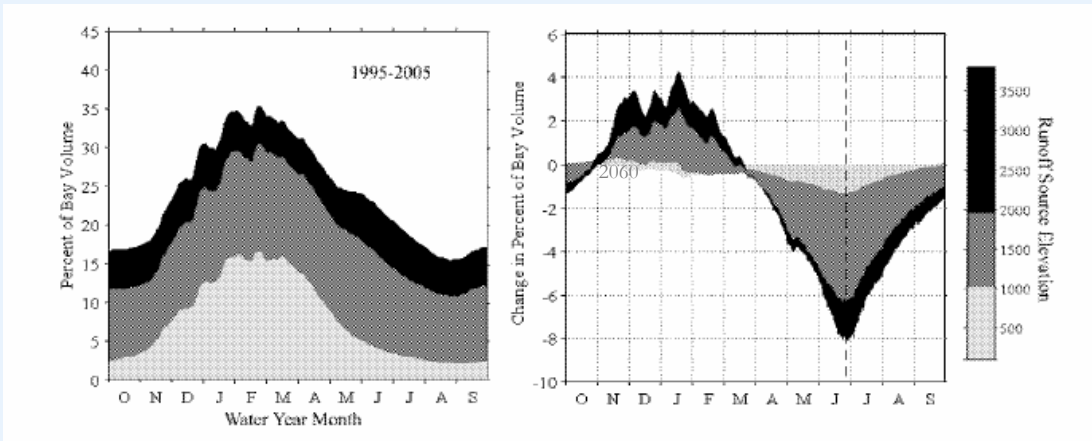




*modulated by water operations

Changes in Runoff Conditions: Low Flows*



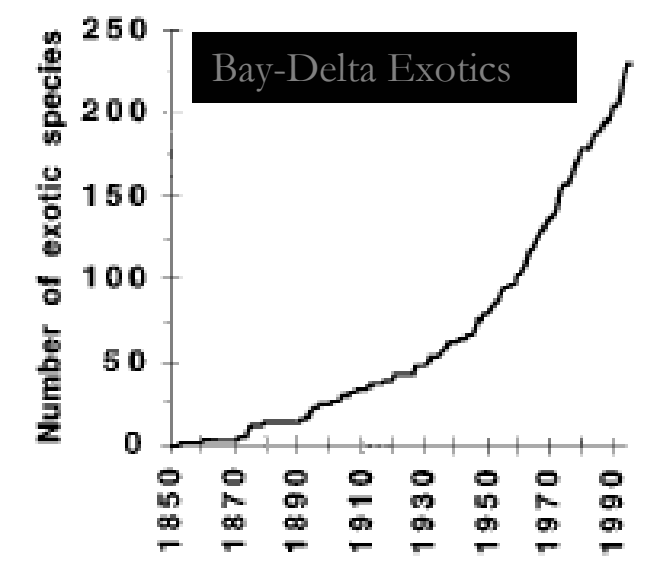


- Decline in spring flows extends low-flow periods
- **Potential for increase in number of days failing to meet current environmental flow standards**
- **Significant decline in Delta water quality (relative to current standards) during low flow events**

Knowles and Cayan, 2004

*modulated by water operations

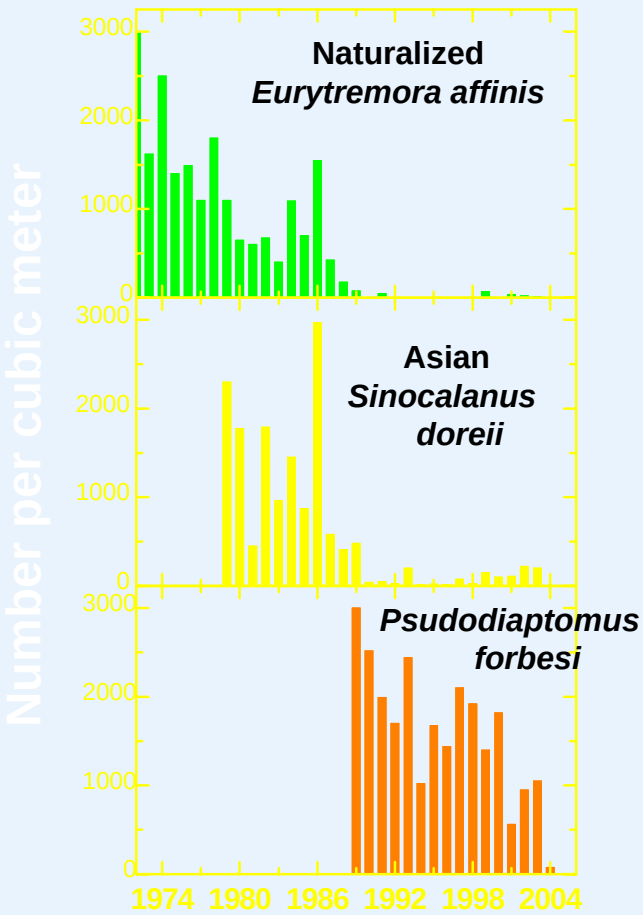
Invasive Species and Ecosystem Change



From Cohen and Carlton, 1998

- **Bay-Delta is the most invaded estuary in the world**
- **Pace of invasions may be accelerating**
- Characteristics of the estuary appear ideal for future invasions from food web disruptors and ecosystem engineers
- Ecosystems will be different and respond in unpredictable ways to future management efforts

Invasive Species and Ecosystem Change



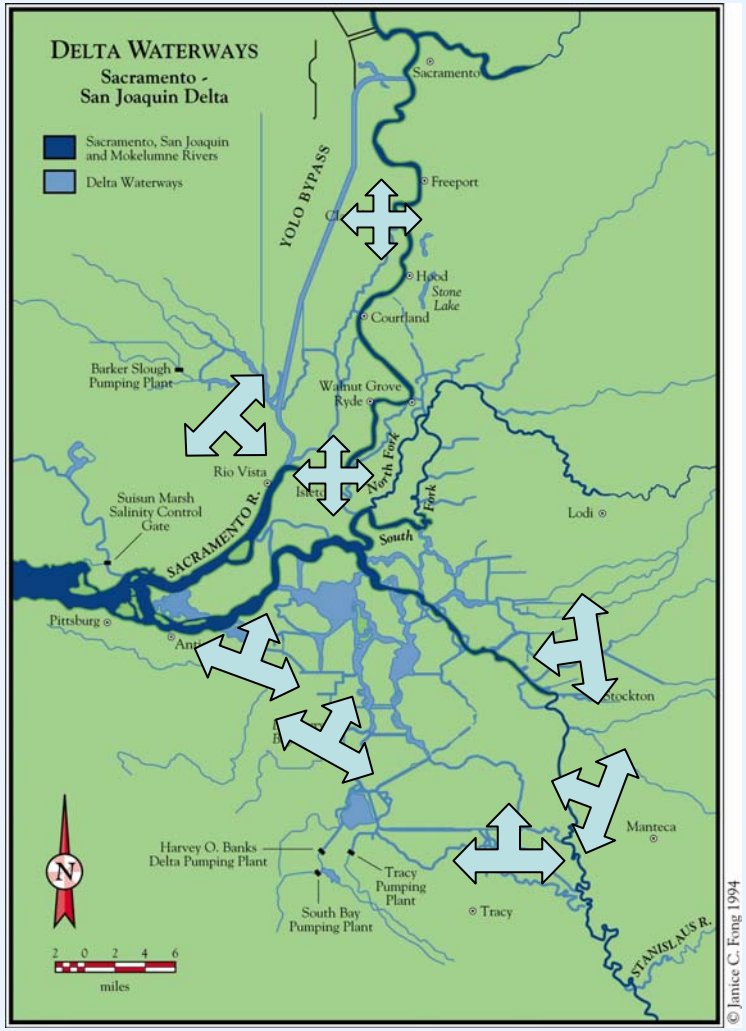
California Department of Fish & Game Zooplankton survey

- Bay-Delta is the most invaded estuary in the world
- Pace of invasions may be accelerating
- **Characteristics of the estuary appear ideal for future invasions from food web disruptors and ecosystem engineers**
- **Ecosystems will be different and respond in unpredictable ways to future management efforts**

Population Growth

- Fastest growing region in California
- Increasing population and water supply pressures
- Demand for conversion of the Delta to homes

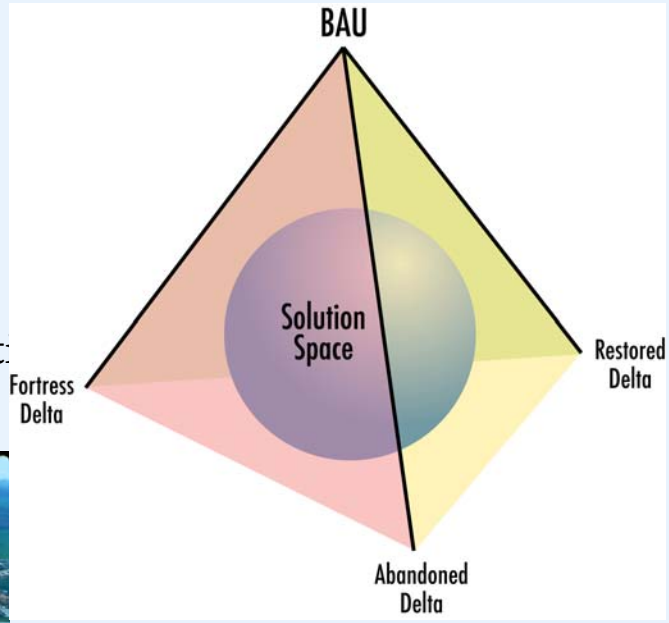
Population Growth



- Fastest growing region in California
- Increasing population and water supply pressures
- Demand for conversion of the Delta to homes

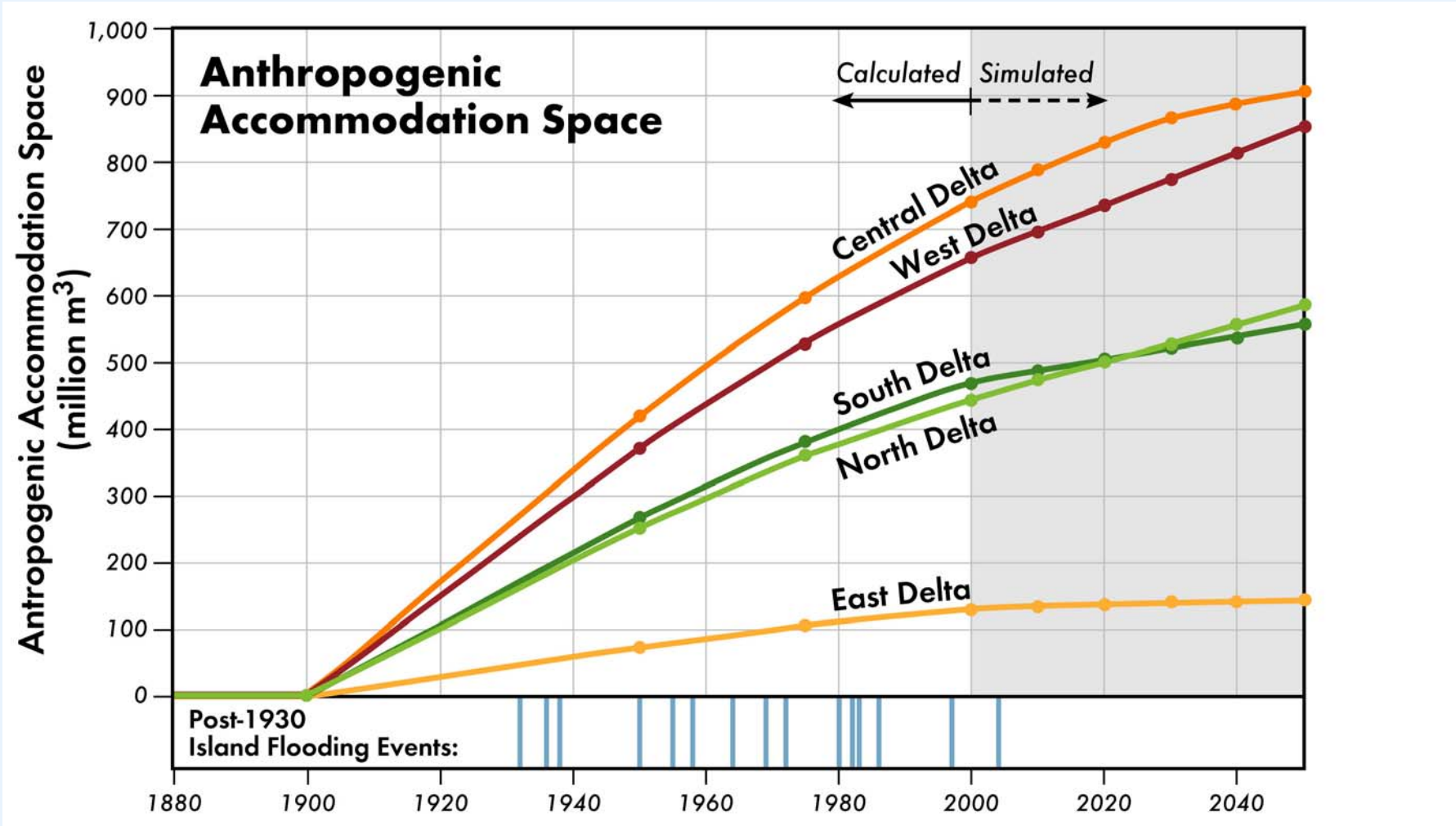
Triangulating a Delta Solution

- Subsidence
- Sea Level Rise
- Seismicity
- Runoff Change
- Invasive Species
- Urbanization/Populat

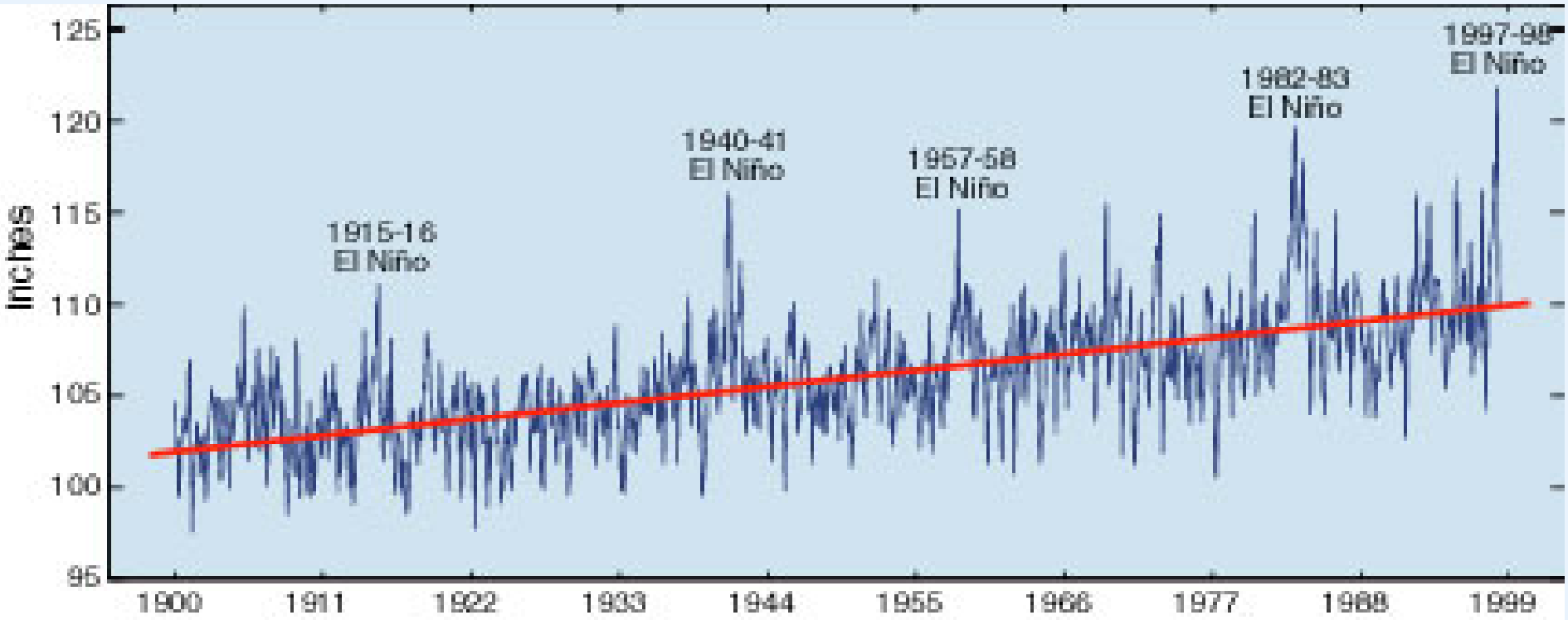


- Water Supply
- Farming
- Native Biodiversity
- Transportation
- Recreation
- Runoff Disposal

Subsidence


Anthropogenic Accommodation Space
Calculated
Simulated
Central Delta
West Delta
South Delta
North Delta
East Delta
Post-1930 Island Flooding Events:
Antropogenic Accommodation Space (million m3)
1,000
900
800
700
600
500
400
300
200
100
0
1880
1900
1920
1940
1960
1980
2000
2020
2040

Sea Level Rise



Ryan et al., 2005